BOAT HULL TUNNEL EXTENSION

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

This invention relates to a boat hull having a bow, a stern, and a keel along its bottom extending from the bow toward the stern and more particularly to a tunnel structure along the bottom of the boat hull in the form of a truncated hollow partial cone and extension indentation parallel to the keel of the boat. The cone indentation has a central axis that is aligned parallel to the keel of the boat in the bow to stern axis of the boat and at an angle downward from the lay of the keel from the bow to the stern of the boat. The cone indentation begins near the apex of the cone and extends at a constant cone angle toward the stern of the boat to the position of a propeller within the cone and then extends from the position of the propeller at a constant radius from the cone's axis to the transom where the base of the indentation is secured to the stern or transom of the boat hull. The partial cone shaped tunnel accommodates the rotary propeller of the boat, and is truncated near its apex where, at that location, it is attached to the keel of the boat and provides a step through which the propeller shaft to the propeller passes from the interior of the boat.

The present invention is an addition to and improvement on the hull shown and claimed in my U. S. Patent 6,544,081, issued April 8,

2003 for BOAT HULL WITH TUNNEL STRUCTURE.

DESCRIPTION OF THE PRIOR ART

Prior art patents have disclosed the use of tunnel shapes along the keel of a boat for several different purposes. Stuart, 3,515,087, discloses a hull tunnel that smoothly increases in size and diameter as extending aft to open fully at the stern. Stuart, 3,626,894, discloses a tunnel in the bottom of the boat that extends aft of the propeller a short distance with a gradually enlarging cross-sectional area preferably formed by diverging sidewalls of the tunnel. Fisher, 3,745,963, discloses a tunnel structure designed to converge water flow and increase water pressure aft of the propeller. Shirley, 4,392,448, discloses the prior art structures intended to produce desireable wake patterns for water skiing. Whitehead, 4,609,360, discloses a tunnel having a section aft of a propeller with side surfaces that widen the tunnel toward the transom. Hankley, 4,622,061, discloses a tunnel with a wedge postioned in the tunnel aft of the propeller. All of Hankley's wedges reduce the tunnel diameter aft of the propeller and along the sides of the tunnel. The prior art has not directed the hull design to the desire to increase the efficiency of the drive from the boat's motor to the propeller and aft of the propeller through the hull and to increase efficiency of driving the boat into a planing attitude.

In an inboard powered boat, it is desireable to have the axis of the propeller shaft as near as possible to parallel to the keel of the boat. It is also desireable to place the driven propeller in its most efficient alignment with the water surface during initial acceleration and after the boat has attained its planing attitude or speed. The prior art has not addressed the angle of the propeller shaft exit from the hull of the boat and the angle of the propeller shaft to the hull of the boat at the position of the propeller when in driving contact with the water. Further, where boat hulls have been provided with bottom concave depressions, those depressions have not been designed to increase the efficiency of the propeller drive forces aft of the propeller blades to raising the stern into a planing attitude.

SUMMARY OF THE INVENTION

The present invention is a modification of the hull of a boat by installing a concave partial cone shaped section along the hull forward of the propeller with the propeller shaft running near the central axis of the partial cone shape and a constant diameter aft of the propeller to the stern. The partial cone shaped section produces a slot or tunnel indentation running longitudinally from the keel, where the propeller shaft exits through the bottom of the hull, to the transom at the stern of the boat. The slot or tunnel is aligned at an angle of approximately 6° to 12° upward from the keel to the position

of the propeller and then parallel to the keel toward the transom. The angle and length of the slot is related to the diameter of the propeller which rotates partially in the slot and is related to the length of the propeller shaft. In the design of the present invention, the propeller shaft exits from the keel of the boat at about 1° to 5° down from the lay of the keel, depending upon the configuration of the bottom of the boat. The relationship of the angle of the slot to the keel and the exit angle of the propeller shaft is calculated to place about 45% to 50% of the propeller turning inside the slot tunnel when the boat is at its planing speed and attitude. The connection of the cone near its apex to the hull causes air to be introduced into the cone along with water to produce an air slot at the hull. Aft of the propeller the tunnel radius is constant to its connection with the transom at the stern.

The purpose of the partial cone shaped tunnel slot of the present invention in the hull of a boat is four fold. The cone shaped air slot allows the suction of the water to be broken at planing through cruising speeds, making it a surface drive, but safer because all of the components are under the boat, unlike other existing surface drives. The cone shaped air slot allows the propeller shaft to be mounted almost parallel to the lay of the keel of the bottom of the boat. The cone shaped air slot and the alignment of the propeller shaft in the slot allows the boat to be operated in shallower waters,

increases efficiency and reduces fuel consumption. The shape of the tunnel aft of the propeller and to the stern is at a constant radius to assist in lifting the stern into planing position.

It is an object of the present invention to improve the efficiency of a boat by modifying the bottom of the boat to permit desired angles of cone-to-keel and propeller-to-keel in the boat hull.

A further object in accord with the preceding object is the formation of a partial cone shaped hollow tunnel slot along the hull of a boat with a continuous cone angle from the lay of the keel to the position of the propeller within the tunnel and then a constant diameter for the tunnel aft of the propeller to the transom of the boat.

A further object in accord with the preceding objects is to assist in lifting the stern of the boat into planing position so that the propeller is operating with about one half of its blades within the tunnel and out of contact with the water under the boat.

Further objects and features of the invention will be readily apparent to those skilled in the art from the appended drawings and specification illustrating preferred embodiments wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG 1 is a side view, partially in section, of a V-shaped hull boat with a partial cone shaped tunnel slot and extension of the present invention.

FIG 2 is a rear elevation of the boat hull of FIG 1.

FIG 3 is an enlarged partial rear elevation of a boat hull like FIG 1 without propeller and rudder and showing the approximate diameter of the tunnel slot at the transom, at the propeller and at the entry of the propeller shaft from the hull to the slot.

FIG 4 is a partial sectional view illustrating the cone angle, the extension radius and propeller shaft angle with respect to the lay of the keel of a boat.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

FIG 1 illustrates an embodiment of the present invention in a V-shaped hull boat 10 with a portion of the stern of the boat removed to show the rudder 12, the propeller 14, propeller shaft 16 and the partial cone shaped tunnel slot 18 and its constant radius portion 19 extending from the keel 20 toward the transom 22. The propeller shaft 16 extends from the interior of the boat through the truncated end 24 of the tunnel slot 18. The internal boat engine is not shown and it

should be well understood how the engine is connected through a transmission to the propeller shaft to exit from the boat hull through a suitable stuffing box and sealing bearing. FIG 2 illustrates the stern of the boat showing the propeller 14 within the open end of the tunnel slot 18 and extension portion 19.

FIG 3 illustrates an enlarged view of the stern or transom 22 of the boat hull 10. At the transom, the open end of the tunnel cone 18 extension 19 connects with the transom at 26 in a circular arc. The internals of the cone 18 include the truncated end 24 where the cone is connected to the hull at the keel 20. Also shown in dotted lines is the circumference of the path 28 of the tip of a propeller 14 (shown in phantom lines). The position of the propeller shaft 16 within the cone shaped tunnel slot as it exits from the truncated end is shown in section as well as it position where the propeller is mounted.

FIG 4 illustrates an enlarged stern portion of the boat hull 10 with the tunnel slot 18 and extension 19 shown in section. The cone shaped tunnel slot extension 19 is attached to the stern 22 at its open end 26 and to the cone portion at the location of the propeller 14. The truncated end closure 24 of the cone portion 18 is attached to the boat hull 10 at the keel 20. The propeller 14 is shown at the end of the propeller shaft 16 where the shaft is supported by a strut 30 fixed to the interior of the tunnel slot 18. The strut includes suitable

bearings for rotary support of the shaft. The shaft 16 passes through the truncated end 24 of the tunnel slot 18 at its connection to the hull 10 at about the keel 20; a suitable bearing and stuffing box seals the shaft at the exit from the hull. The rudder, not shown, would be toward the transom and behind the propeller either within the tunnel slot extension 19 or aft of the transom. Twin rudders could be mounted to the hull separately from the tunnel.

Shown in FIG 4 in angular arrows is the angle X between the lay of the keel and the axis of the propeller shaft 16, the angle Y between the lay of the keel and the axis of the partial cone shaped tunnel slot 18 to the position of the propeller with the constant radius extension 19 aft of the propeller, and the angle Z between the truncated end 24 of the tunnel slot 18 where it is almost perpendicular to the lay of the keel and normal to the axis of the propeller shaft. The difference between the radius of the cone portion of the tunnel slot 18 at the location of the propeller and the radius of the extension 19 aft of the propeller represented by the distance marked R_e. The projection of the cone radius to the transom without the reduction in radius for the extension 19 is shown in dot-dashed lines above R_e.

The "lay of the keel" means the generally straight line of the keel toward the transom and represents the part of the boat that will be in contact with the water when the boat has obtained planing

attitude or speed. "Normal to the axis of the propeller shaft" means a truncation of the cone shape at an angle that will provide the desired entry of the propeller shaft from the interior of the boat hull to the interior of the cone. The exit of the propeller shaft through a truncation as close as possible to perpendicular to the shaft will permit better sealing at the exit bearing. It is the intent of the alignments of the present invention to place the axis of the propeller shaft as flat as possible, that is horizontal, when the boat is in it planing attitude. It is also the intent of the present invention to position the propeller within the cone tunnel in a position where at least half of the propeller is engaging the water as the boat is propelled. To accomplish those intents, the cone tunnel starts far ahead of the propeller location and tapers upward from the keel toward the stern. The forward end of the cone tunnel is truncated at its attachment to the boat at the keel to establish a step that breaks the suction between the hull and the water and provides a path for water and air to enter the cone to a position for engagement with the propeller. The cone angle of the tunnel is a constant angle from the keel attachment to the position of the propeller within the cone. At the position of the propeller, the tunnel then has a constant radius extension R_e to the transom and is a constant circular partial cone with a constant radius extension each having a thickness consistant with the thickness of the hull, open at the bottom to establish a hollow partial cone 18 and extension 19, with the sides of the cone and

extension attached to the hull of the boat along the edges of the cone and extension from the connection to keel 20 at the truncated end to the connection of the extension to the transom 22.

As shown in FIG 4, the angle X between the lay of the keel and the axis of the propeller shaft is preferably as small as possible. The design of the engine and transmission in providing power to the propeller shaft requires that there be some angle to get the shaft out of the hull. In accord with the present invention, the angle X should be between 1° and 5°. The angle Y between the axis of the cone tunnel and the lay of the keel is, to some extent, determined by the diameter of the propeller and the position of the propeller within the cone. In accord with the present invention, the angle Y should be between 6° and 12° upward from the keel to the propeller position in the tunnel and then constant to the transom. The angle between the axis of the propeller shaft and the interior surfaces of the cone should be between about 5° and 10°. The angle Z between the small truncated end of the cone at its attachment to the keel and almost perpendicular to the keel is determined to some extent by the axis of the propeller shaft. In accord with the present invention, the angle Z is the same as the propeller shaft angle with respect to the lay of the keel. The diameter $_{Re}$ of the extension 19 is determined by the diameter of the propeller and its position within the cone shaped portion. The propeller should have a clearance of about 1 inch to the interior

surface of the cone at the extension. That distance in radius for the extension then remains constant to the connection with the transom.

An example of a boat that could be constructed using the design features of the present invention is illustrated in FIGs 1-4 as a Vee hull boat about 21 feet in length with a beam of 95.5 inches. In that boat, the Vee angle is 15^{o}, shown at V in FIG 3. The length of the cone tunnel and extension placed within the hull is 60" from the transom to the truncated end. The angle X betweem the lay of the keel and the axis of the propeller shaft is 3^{o}, the angle Y of the cone tunnel interior surfaces with respect to the axis of the propeller shaft is 7^{o}, the angle Z is 3^{o}. In such a boat, the cone is about 7 inches in radius at the propeller location, the radius of the aft extension of the tunnel from the propeller remains at 7 inches, and the radius of the truncated end connected to the keel forward of the propeller is about 4 inches. The tunnel extension in such a boat would be about 14 to 18 inches from the transom to the propeller with the strut forward of the propeller. These dimensions are representative of the angles and lengths and are varied depending upon the hull design, the length of the hull, the selected propeller and drive motor, and the intended use of the boat.

It should be understood that the truncated hollow partial cone tunnel structure and constant radius extension shown as

installed for use in a single propeller Vee hull and would be useful as well in twin propeller driven hulls. The tunnel and extension would also be applicable to other hulls such as flat bottom boats, catamarans and trimarans. Further, the constant radius extension could be an insert placed in a truncated cone tunnel at the postion of the propeller and extending toward the stern at a constant radius to accomplish the desired efficiencies as described above.

The improved efficiency and reduced fuel consumption using the hull construction of the present invention is accomplished by getting the boat from standstill to planing attitude in a shorter period of time and by placing the drive propeller in its most efficient alignment with the water surface when the boat is planing. The constant radius extension 19 from the cone portion 18 forces the drive energy generated by the propeller to concentrate in the extension to the transom and thus increases the force at the transom to raise the boat into planing attitude. When in planing attitude, the propeller is operating with about one half of its blades out of the water and within the cone. The propeller should be constructed using modern technology that incorporates a ventilating aspect for a propeller operating in an air and water mix.

While certain preferred embodiments of the invention have been specifically disclosed, it should be understood that the

invention is not limited thereto as many variations will be readily apparent to those skilled in the art and the invention is to be given its broadest possible interpertation within the terms of the following claims.